

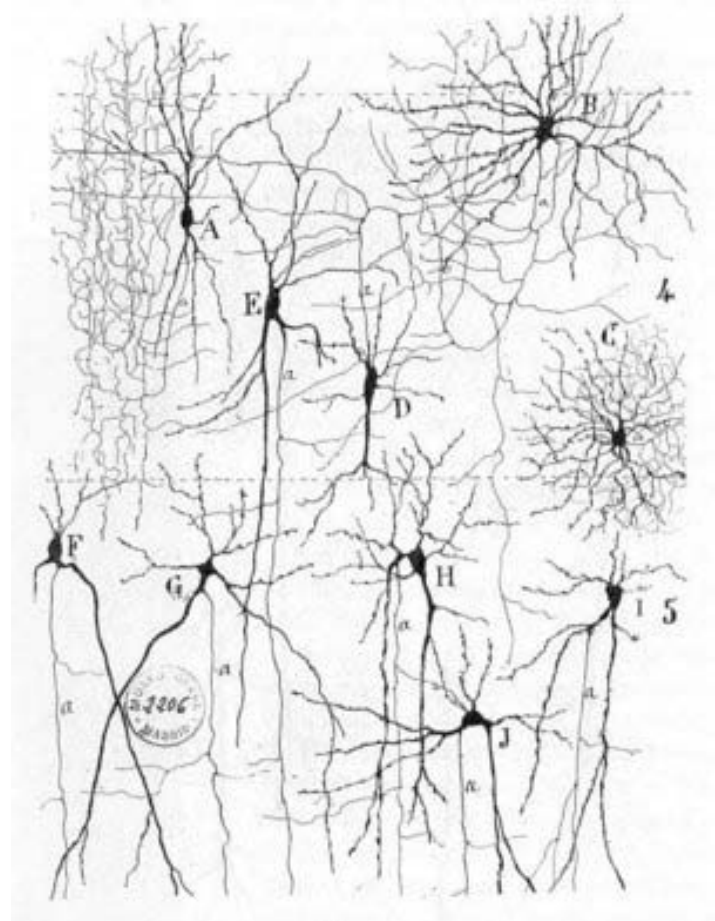
Network Analysis Tools

GIS III: GIS Analysis



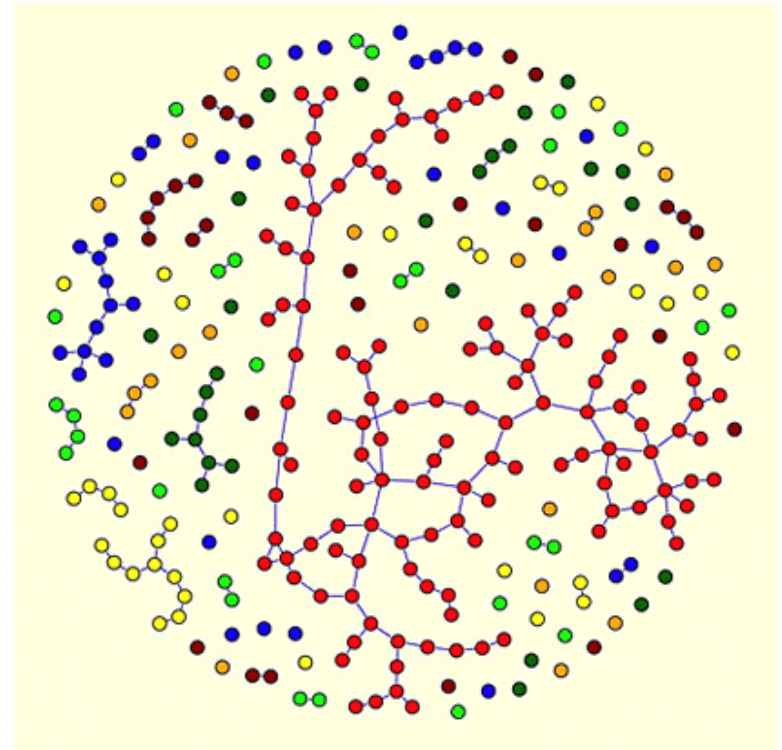
Learning Objectives

- Introduce basic components of a network
- Understand general network analysis concepts
- Offer a few examples of current application
- Introduce network analysis in ArcGIS

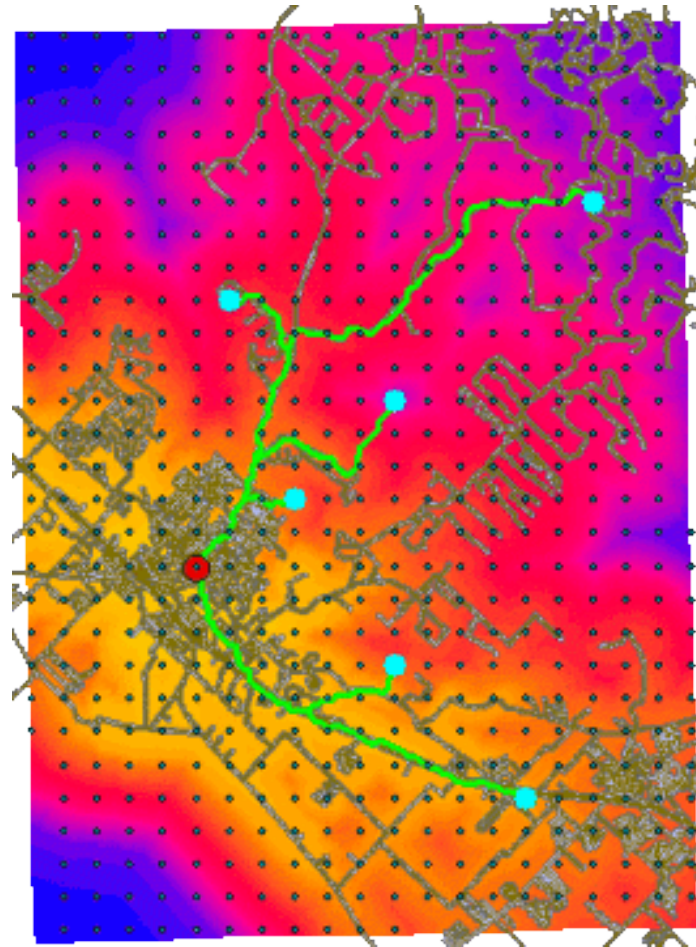


What is a Network?

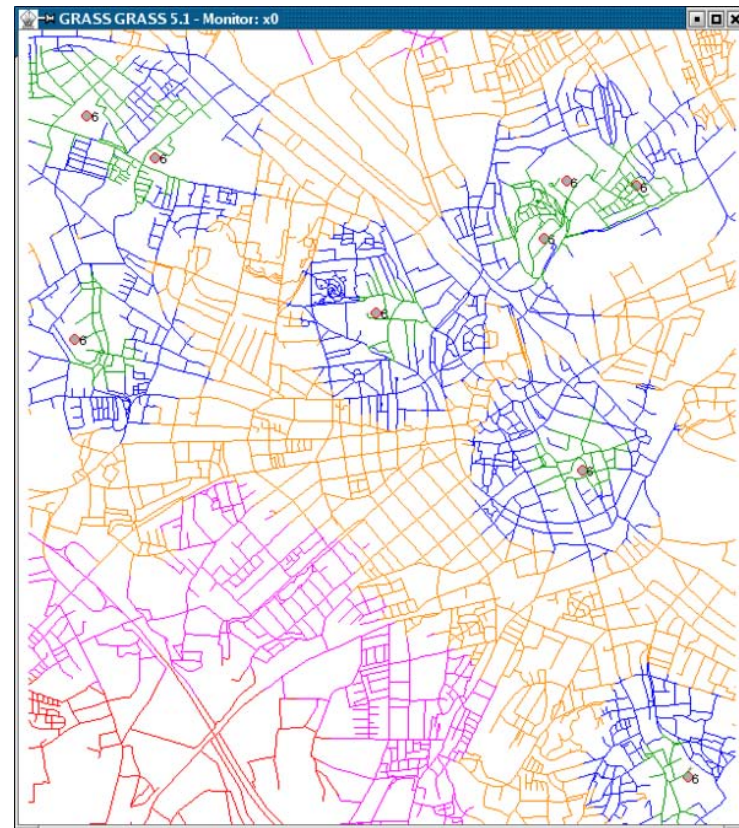
- Interconnected set of points (nodes) and lines (edges)
- Examples
 - Information networks
 - Social networks
 - Stream networks
 - Transportation networks
- Connectivity allows for analysis/problem solving



- A set of interconnected line entities whose attributes share some common theme primarily related to flow
- Network lines define relationships between nodes
- Flow types:
 - Data
 - Objects
 - Materials



- **Rules** dictate how objects can move through the network
- **Types**
 - Direction – one way streets
 - Barriers
 - Time of day
 - Node restrictions – stroke centers
 - Sequence – stop 1 then stop 2



Networks and GIS

- Cost:

What is the impact of an object flowing through the network?

- Types

- Time
- Distance

Based on connectivity, flow, and rules

Get directions

My places

A

B

C

D

E

F

G

H

450 W State St, Boise, ID 83702

123 South 27th St, Billings, MT 59101

2 N. Meridian Street, Indianapolis, IN 46204

2920 College Ave, Escanaba, MI 49837

300 Main Street, Lewiston, ME 04240 (Central Maine)

565 Corning Tower Albany, New York 12237

628 North 4th Street, Baton Rouge, LA 70802

Science Drive, Durham, NC

Add Destination - Show options

GET DIRECTIONS

Suggested routes

I-85 N

6,502 mi, 4 days 12 hours

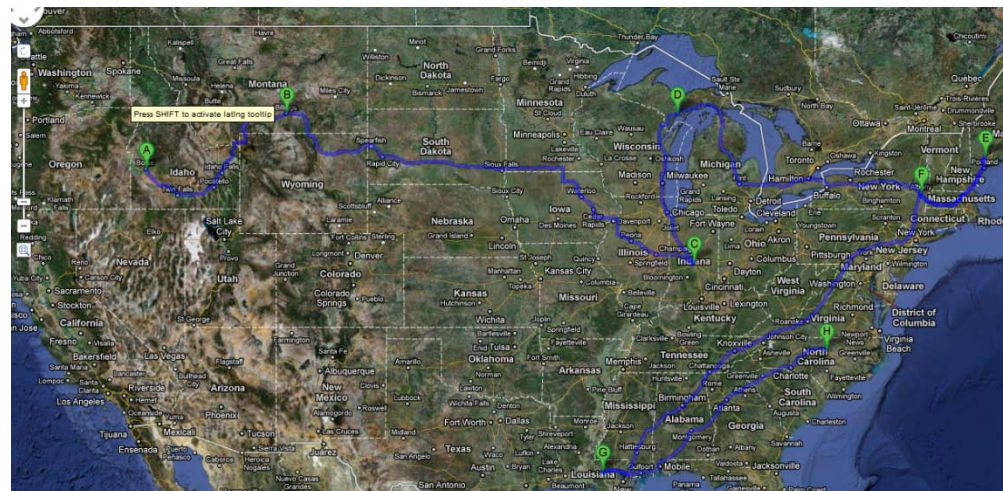
Driving directions to Science Dr, Durham, NC

3D▶

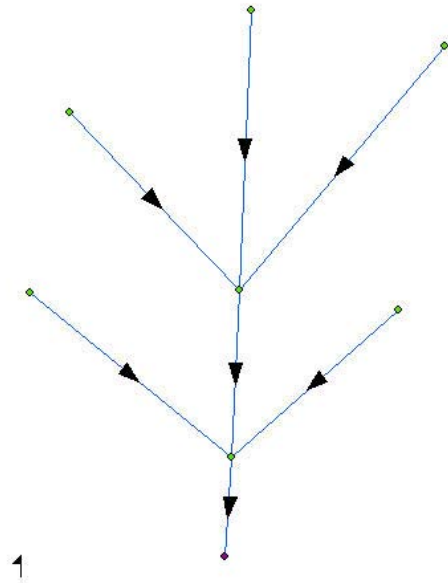
This route has tolls.

This route crosses through Canada.

This route may have road closures.

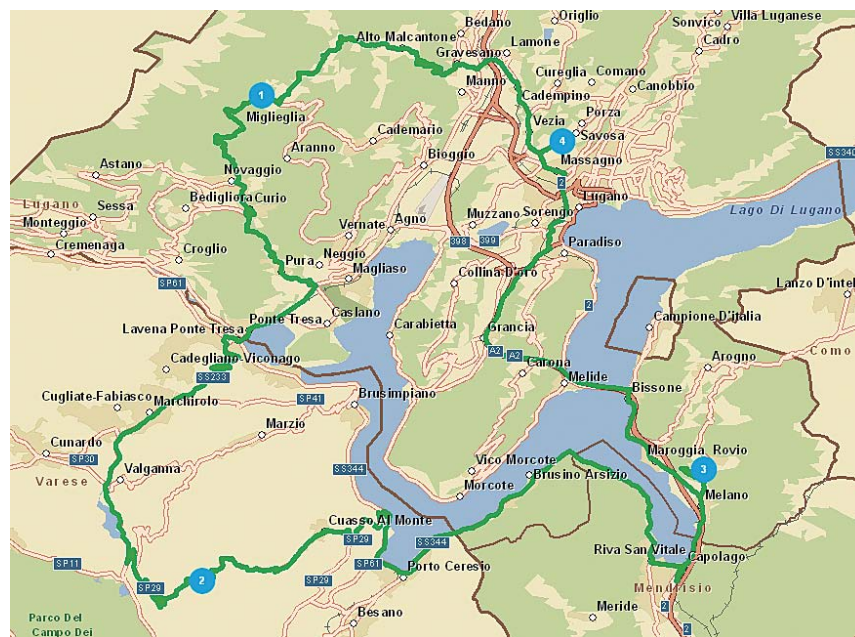


- Set of nodes connected by lines
- Represent some type of flow
- Incorporate flow rules
- Rules determine cost



Network Analyst

- Network analysis is a set of analysis techniques used with networks
- Network Analyst is the ESRI extension that performs network analysis in ArcMap
- Network Analyst uses network datasets
- Types of analysis:
 - Route
 - Service areas
 - Closest facility
 - Origin-destination cost matrix
 - Vehicle routing
 - Location allocation

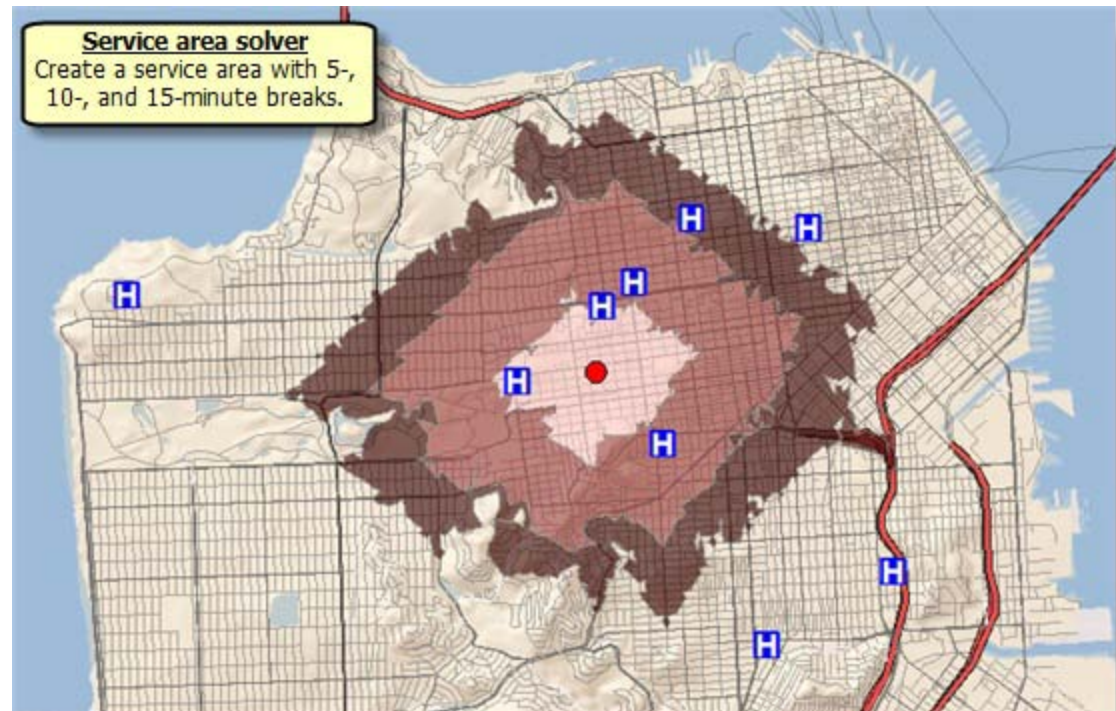


- Route:
 - Can be simple – finding driving directions between two points
 - More complex – best route between 10 different stops
- “Best” can mean different things:
 - Shortest distance
 - Quickest
 - Most scenic
 - No highways



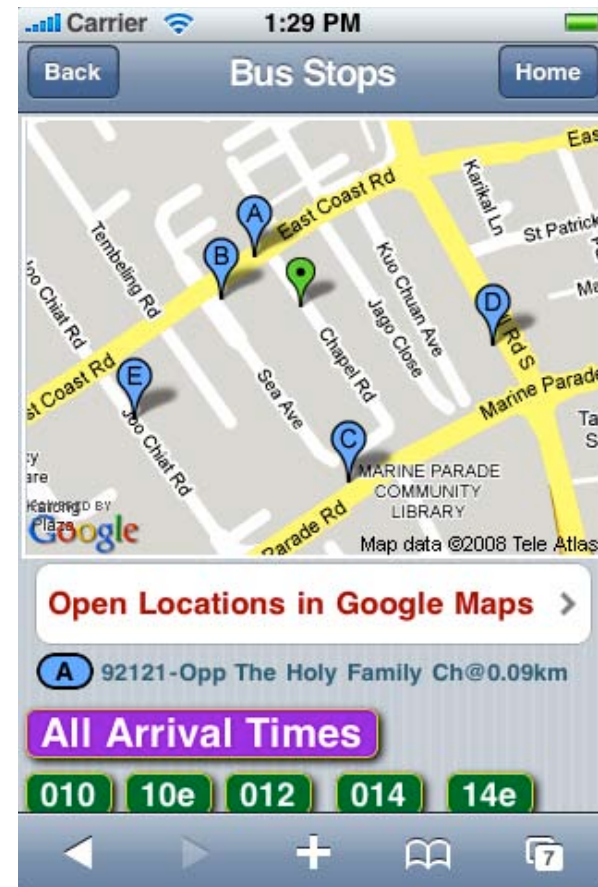
Service areas:

- Calculate an area based on time or distance from an input
- Good for estimating populations
- Different than a simple buffer



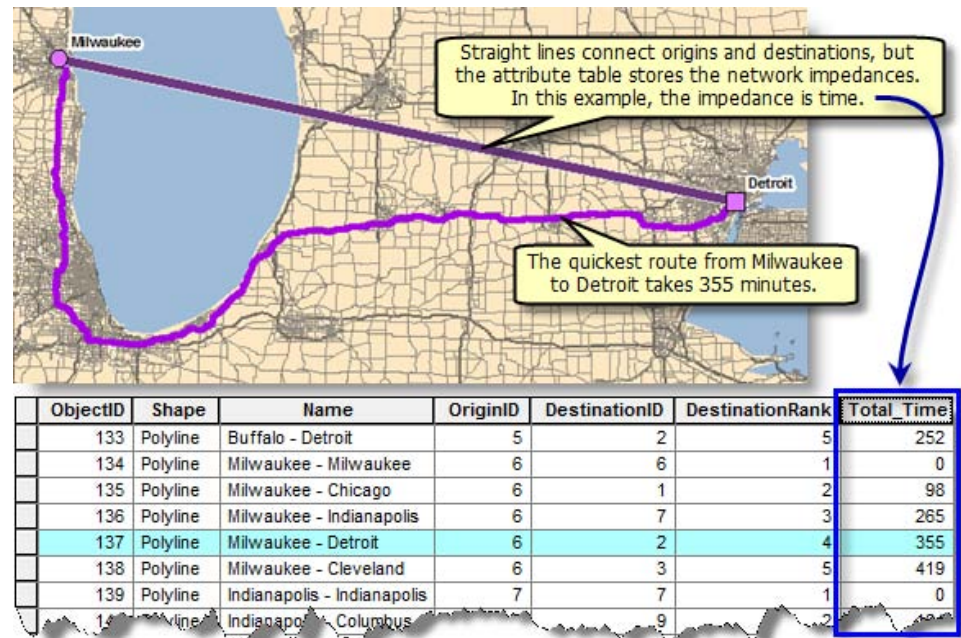
Closest facility:

- Calculate the nearest X number of facilities to an incident or point of interest
- Closest can be based on network distance or time
- Set up a cutoff
 - Find all the hospitals within 5 minutes of an accident
 - Find all the clinics within 2 miles of a home address



Origin-destination cost matrix:

- Creates a cost matrix from multiple origins to multiple destinations
- Good for calculating distance or time between multiple start and end points



Geographic and Sociodemographic Disparities in Drive Times to Joint Commission–Certified Primary Stroke Centers in North Carolina, South Carolina, and Georgia
Prev Chronic Dis 2011;8(4):A79

Jenna A. Khan, MPH; Michele Casper, PhD; Andrew W. Asimos, MD; Lydia Clarkson, MPH; Dianne Enright, GISP; Laura J. Fehrs, MD; Mary George, MD, MSPH; Khosrow Heidari, MA, MS; Sara L. Huston, PhD; Laurie H. Mettam, MEd; G. Ishmael Williams, Jr, MA; Linda Schieb, MSPH; Sophia Greer, MPH

Driving times and distances to hospitals with percutaneous intervention in the United States: Implications for prehospital triage of patients coronary with st-elevation myocardial infarction
Circulation 2006;113;1189-1195

Brahmajee K. Nallamothu, Eric R. Bates, Yongfei Wang, Elizabeth H. Bradley, and Harlan M. Krumholz

Access to primary percutaneous coronary intervention for ST-segment elevation myocardial infarction in Canada: a geographic analysis
Open Medicine 2010;1(1):e21

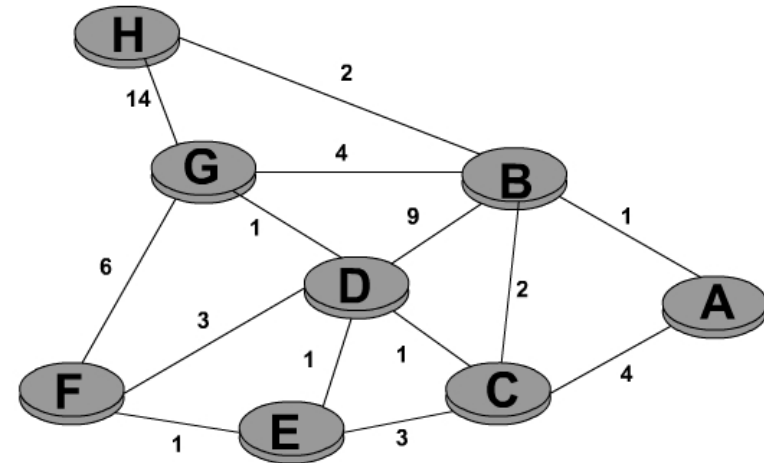
Alka B. Patel, Jack V. Tu, Nigel M. Waters, Dennis T. Ko, Mark, J.Eisenberg, Thao Huynh, Stéphane Rinfret, Merril Knudtson, and William A. Ghali

- Network locations
- Network Analyst workflow
- Useful analyses
 - Routes
 - Service areas
 - Closest facility
 - Origin destination cost matrices



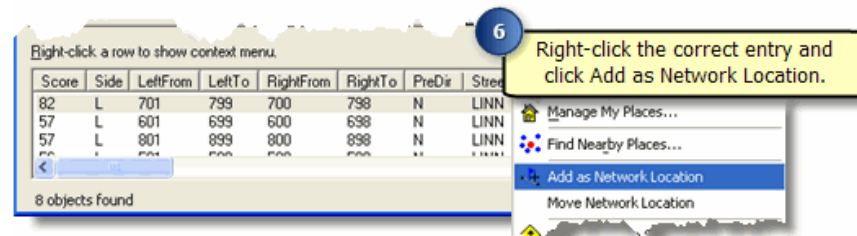
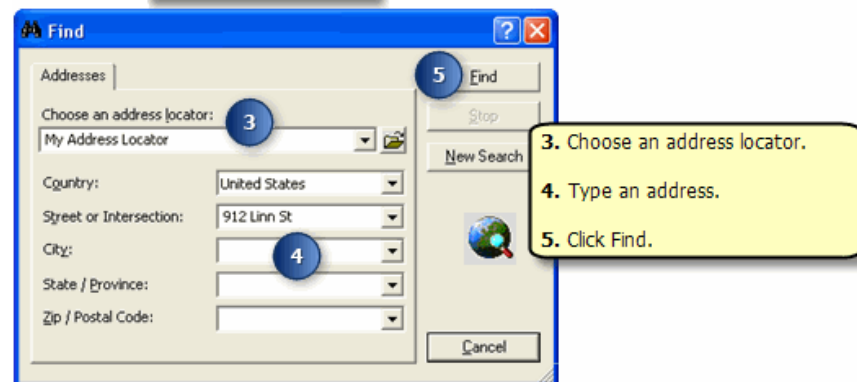
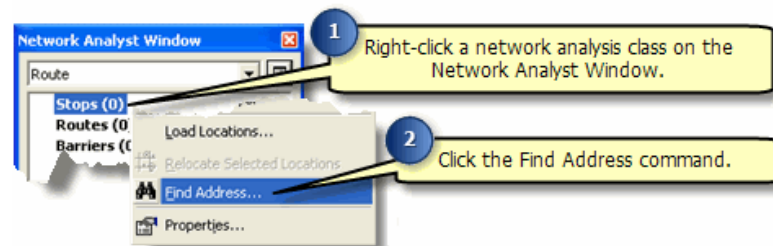
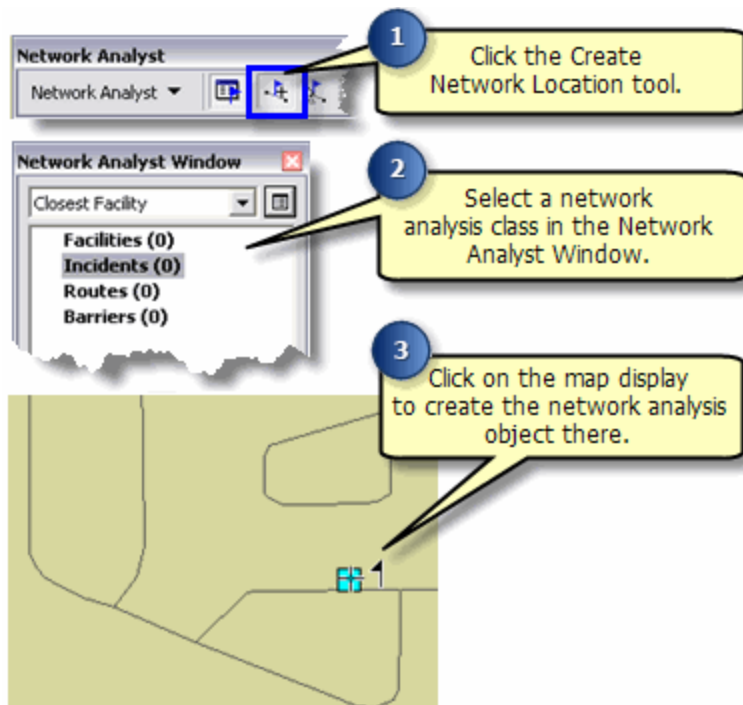
Review and New Terms

- A network is made up of edges and nodes
 - Edges are the “lines” of the network
 - Nodes are physical locations
- Edges for all cases discussed in this module will be roads
- Types of locations (nodes)
 - Stops
 - Barriers
 - Facilities
 - Incidents
 - Origins
 - Destinations

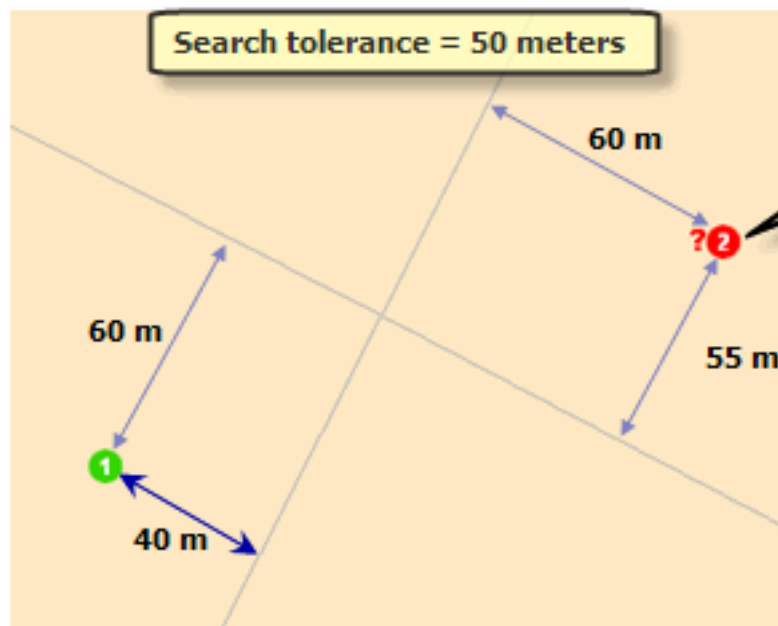


Network locations

- Adding your own network locations to a network
 - Create Network Location tool
 - Load Locations tool
 - Find tool



- Finding network locations
 - Search tolerance
 - Snapping environment



Layer Properties

General | Layers | Source | Analysis Settings | Accumulation | Network Locations

Network Location Field Mapping

Location Type: Stops

Property	Default Value	Candidate Fields
Name		Name;Address;Label;Location;St...
RouteName		RouteName;Route;RouteID
TimeWindowStart		TimeWindowStart1;TWStart1;Fro...
TimeWindowEnd		TimeWindowEnd1;TWEnd1;ToTi...
SourceID	<None>	SourceID;SID;Source
SourceOID	-1	SourceOID;S0ID
PosAlong	0	PosAlong;PA;Pos

Load... Save...

Finding Network Locations

Search Tolerance: 5000 Meters

Snap To:

☒ Closest ☐ First

Name	Shape	Middle	End
Streets	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Railroads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Snap_ND_Junctions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

OK Cancel Apply

Network Analyst workflow

1. *Create network analysis layer*
2. Add network locations
3. Set analysis properties
4. Perform analysis and display results